

Co-occurrence of whales and Dungeness crab-pot fishing gear in the Bay Area

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One of the primary remaining human impacts on large whales is entanglements with fishing gear. In recent years the number of entangled whales has increased along the U.S. West Coast. Records show the vast majority of entanglements occur in trap/pot fishing gear with most reports occurring off California.

We used 10 years (2008-2017) of crab pot and whale distribution data collected on the Applied California Current Ecosystem Studies (ACCESS) cruises. We modeled crab pot and whale densities in relation to climate, oceanography, and bathymetry. We estimated co-occurrence by calculating the product of whale and pot densities and used it as a proxy for entanglement risk.

Average risk for all years and months showed different patterns for blue and humpback whales (Figure 1).

Since whale prey is expected to be compressed close to shore in

warm water years, we compared averages of May risk between warm (2010, 2013) and cold (2008, 2009, and 2011) years (Figure 2). Warm years showed higher risk that was more concentrated close to shore.

To examine the accuracy of our modeled entanglement risk in predicting entanglements, we compared our predictions to observed entanglements for the study region. We scaled our index so that the maximum predicted risk aligned with the greatest number of entanglements observed in any month of our study period (7 in both May and June of 2009). On an annual basis, our predictions aligned well with observed entanglements (Figure 3). Overall, the predictions captured the significant rise in entanglements in 2016-17, though 2015 was under-predicted.

With improved modeling driven by expanded data, our approach can offer important

insights into how to mitigate whale entanglement.

Main Points

- High risk areas occur northwest of Half Moon Bay, off San Francisco and Marin County, near the Farallon Islands and northwest of Point Reyes.
- Model predictions show higher risk, closer to shore in warm water years for humpback whales.
- Annual predictions of humpback entanglement risk align well with observed entanglements and reproduce the strong increase observed in 2015-2017.

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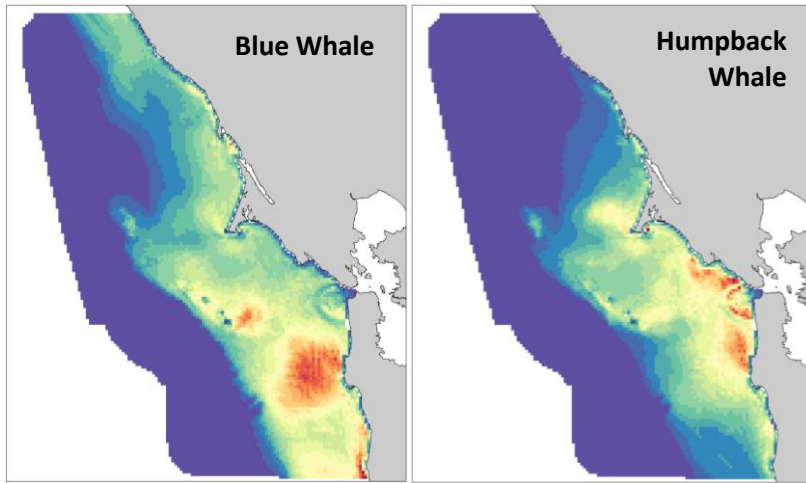


Figure 1. Mean modeled co-occurrence of whale with crab pots for May and June of 2008-2017. Warmer colors represent greater risk.

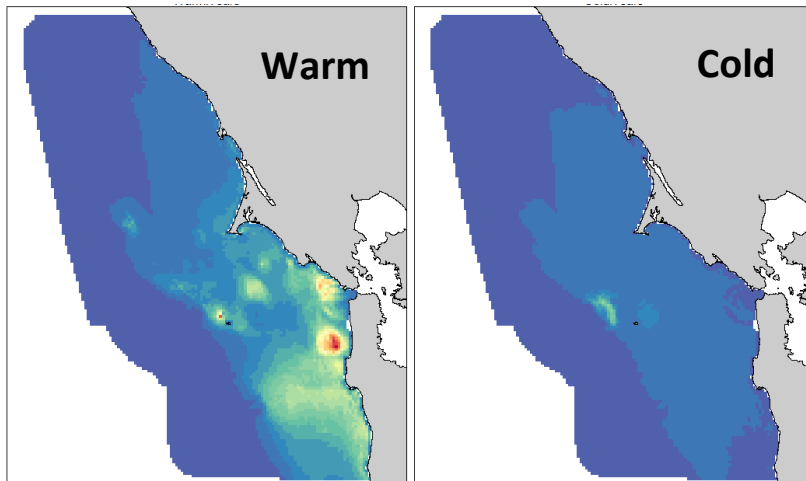


Figure 2. Humpback whale entanglement risk distribution in representative warm (2010, 2013) and cold (2008, 2009 and 2011) years.

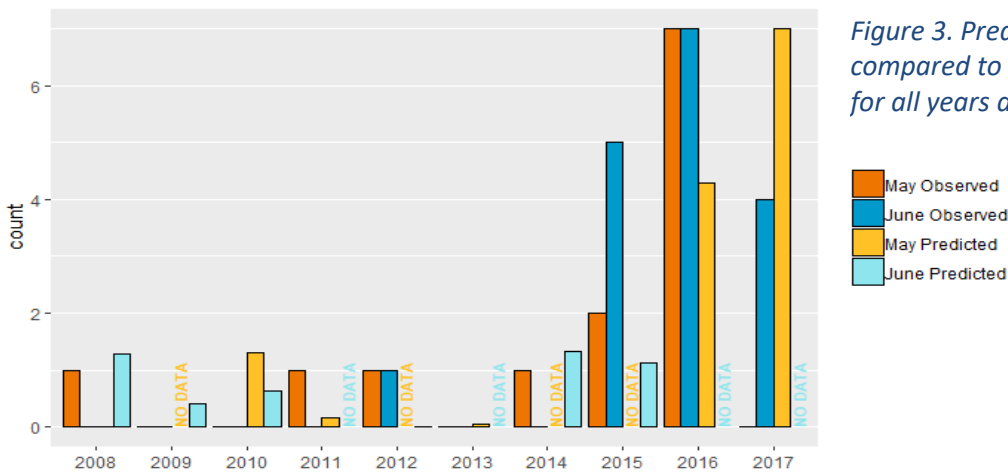


Figure 3. Predicted entanglement risk compared to observed entanglements for all years and months of the study.